

1 decomposition of an organic silicon precursor is described. Such process
2 does not include adding an oxide of hydrogen, therefore a first or
3 theoretical deposition rate is inherent. Subsequently a process providing
4 for the decomposition of an organic silicon precursor with the addition
5 of an oxide of hydrogen is described. Such process provides for a
6 reduced or actual decomposition rate. Hence, such amendments do not
7 introduce new matter. Claims 39-48 remain pending in the above-
8 referenced application.

9 10 Claim Objections

11 Claim 46 is objected to and is amended to correct the informality
12 pointed out by the Examiner. As the Examiner suggests the phrase
13 "cold hot" is amended to recite "cold wall."

14 15 Claim Rejection under 35 U.S.C. §112, first paragraph:

16 Claims 39-42, 47 and 48 stand rejected under 35 U.S.C. §112, first
17 paragraph, as containing subject matter which was not described in the
18 specification in such a way as to enable one skilled in the art to which
19 it pertains, or with which it is most nearly connected, to make and/or
20 use the invention. Applicant traverses.

21 Applicant respectfully asserts that whether or not Applicant has
22 provided the correct theory under which the invention of the instant
23 application, as recited in Claims 39-42, 47 and 48, operates is immaterial

1 to the requirement of 35 U.S.C. §112, first paragraph. What is material,
2 is that Applicant provide the best mode known at the time the invention
3 was made and that the description provided be in such full, clear,
4 concise and exact terms as to enable any person skilled in the art to
5 which it pertains to use the invention. Applicant asserts that such is
6 provided.

7 While the Examiner may believe that the addition of water or
8 hydrogen peroxide can either have no effect or only increase the rate of
9 decomposition of the organic precursor, Applicant in fact found that a
10 decrease in the rate was observed. Further, Applicant asserts that
11 knowledge of the actual mechanism by which the invention of
12 Claims 36-42, 47 and 48 actually reduces the decomposition rate of the
13 organic silicon precursor is not necessary for one of ordinary skill in the
14 art to practice such invention. Applicant provides in the specification
15 specific volume percentages of water and/or hydrogen peroxide that were
16 found effective, alternate methods of forming mixtures of the added
17 water and/or hydrogen peroxide with any of the various organic silicon
18 precursors described, effective temperature ranges, pressures and all of
19 the other necessary parameters to practice such invention. Thus
20 Applicant asserts that the requirement of §112, first paragraph, to
21 provide such full, clear, concise and exact terms as to enable any person
22 skilled in the art to which it pertains to use the invention is met.
23

1 With regard to the Examiner's reading and application of the cited
2 references Sukharev at column 3, line 66 to column 4, line 13, and the
3 article by IslamRaja et al. at page 722, last paragraph, right-hand
4 column, Applicant suggests that the Examiner has improperly considered
5 the material presented therein.

6 For example, in Sukharev, rather than a mixture of an organic
7 silicon precursor and water and/or hydrogen peroxide as recited by
8 Applicant in Claims 39-42, 47 and 48, Sukharev provides in addition to
9 such materials, oxygen and ozone as well as providing that the mixture
10 receive ultraviolet rays from an external source of such energetic
11 radiation. Applicant takes note that it is well known in the chemical
12 arts that the application of ultraviolet radiation to oxygen and ozone
13 provides for, among other things, the forming of extremely reactive
14 atomic oxygen. Thus it is certainly possible that where Sukharev reports
15 an increase in the decomposition rate of TEOS, such can be the result
16 of the formation of atomic oxygen rather than the presence of water
17 and/or hydrogen peroxide as the Examiner represents.

18 In IslamRaja, the addition of water and/or hydrogen peroxide is
19 never considered. Rather, IslamRaja only considers modeling the low
20 pressure chemical vapor deposition of silicon dioxide from TEOS to
21 propose a mechanistic theory to explain the observed deposition. In the
22 course of arriving at a conclusion as to the mechanistic theory, IslamRaja
23 discusses a previously proposed theory of Shimogaki et al., which is at

1 page 722, the last paragraph of the right-hand column, such as referred
2 to by the Examiner. Applicant takes note that the proposed reaction
3 mechanism of Shimogaki, offered in support of the Examiner's holding
4 that the addition of water and/or hydrogen peroxide speeds up the
5 decomposition of the precursor, never discusses the actual rate of
6 decomposition or the addition of water and/or hydrogen peroxide. Hence
7 Applicant asserts that such reference cannot support the Examiner's
8 allegation that the decomposition of the precursor is sped up by the
9 addition of water and/or hydrogen peroxide.

10 Finally, Applicant asserts that the theory presented by the
11 specification, i.e. that an equilibrium between the organic silicon
12 precursor and an intermediate exists, is shifted by the addition of water
13 and/or hydrogen peroxide and that such shifting reduces the
14 decomposition rate of the precursor, may be correct. To this effect,
15 Applicant provides herewith a recent article (*J. Zabicky and H. Realpe,*
16 *Gas-Phase Hydrolysis of Tetraethyl Orthosilicate (TEOS), Journal of*
17 *Metastable and Nanocrystalline Materials, pp. 203-208, vols. 3-6 (1999))*
18 *that illustrates a hydrolysis reaction of TEOS in the presence of water,*
19 *see Eqn. 2. Applicant asserts that such a hydrolysis reaction is generally*
20 *known to be reversible. Therefore since such a reaction would reduce*
21 *the instant concentration of an organic silicon precursor such as TEOS,*
22 *where the intermediates formed have a lower rate of decomposition too*
23 *silicon oxide than the starting material, Applicant's theory is correct.*

1 Applicant further asserts that such a hydrolysis reaction is within the
2 scope and spirit of Applicant's teachings as it is (1) an inherent reaction
3 of TEOS with water and thus included within the application's teachings,
4 and (2) it is possible for such to reduce the decomposition rate of the
5 organic silicon precursor. However, such an alternative is offered herein
6 not as a proposal of an actual mechanism or explanation as to how
7 Applicant's invention works. Such an offering or showing is NOT
8 required. Rather such is respectfully offered for the Examiner's benefit,
9 with the hope that such will expedite the prosecution of the instant
10 application.

11 Hence Applicant asserts that the rejection of Claims 39-42, 47 and
12 48 is shown to be improper. It follows then that the rejection must be
13 withdrawn, which action is earnestly sought.

14
15 **Claim Rejection under 35 U.S.C. §112, second paragraph:**

16 Claim 44 stands rejected under 35 U.S.C. 112, second paragraph,
17 as being indefinite for failing to particularly point out and distinctly
18 claim the subject matter which applicant regards as the invention.
19 Specifically the Examiner states that silane is not an organic silicon
20 compound. Applicant has amended Claim 44 to remove silane from the
21 group of materials. Thus this rejection is moot.

1 Claims 39-42, 47 and 48 stand rejected under 35 U.S.C. 112,
2 second paragraph, as being indefinite for failing to particularly point out
3 and distinctly claim the subject matter which applicant regards as the
4 invention. Specifically, the Examiner essentially states that Claims 39,
5 47 and 48 are considered indefinite because the relative terminology of
6 "reducing" used in such claims cannot be determined with respect to
7 what decomposition rate is reduced. Applicant traverses.

8 M.P.E.P. §2173.05(b), citing to *Seattle Box Co., v. Industrial Crating*
9 *& Packing, Inc.*, 731 F.2d 818, 221 USPQ 568 (Fed. Cir. 1984), states
10 that "[t]he fact that claim language, including terms of degree, may not
11 be precise, does not automatically render the claim indefinite under
12 35 U.S.C. 112, second paragraph." Such section further states that
13 "[w]hen a term of degree is presented in a claim, first a determination
14 is to be made as to whether the specification provides some standard for
15 measuring that degree. If it does not, a determination is made as to
16 whether one of ordinary skill in the art, in view of the prior art and
17 the status of the art, would be nevertheless reasonably apprised of the
18 scope of the invention" (emphasis added). Applicant respectfully asserts
19 that the Examiner cannot have made the determination highlighted in the
20 above quotation from the M.P.E.P., for if such a determination had been
21 made, no rejection of Claims 39, 47 and 48 would now be argued.

22 Applicant respectfully asserts that it is well known in the art that
23 there are many alternative process conditions for the chemical vapor

1 deposition of silicon oxides that employ organic silicon precursors. These
2 many alternative process conditions vary with regard to, for example,
3 deposition temperature, deposition pressure, the use or non-use of a
4 plasma assist, the concentration of the various reactive species, the
5 nature of such reactive species (i.e. TEOS, TMCTS, FTES or the like),
6 whether or not additives such as oxygen, ozone or conductivity dopants
7 are present and the physical nature of the CVD reactor employed. It
8 is also well known that the decomposition rate of the one or several
9 silicon organic precursors selected will vary widely as a function of any
10 one or several of these alternate process conditions. These processing
11 variations being known, and the variation of decomposition rates as a
12 function of these process variations also being known, Applicant asserts
13 that one of ordinary skill in the art would be well informed of the
14 scope of the invention as recited in Claims 39, 47 and/or 48. Further,
15 as Applicant supplies exemplary deposition conditions such as
16 temperature, pressures, concentrations and even the CVD reactor style
17 used, Applicant asserts that the determination of the specific amount of
18 such "reducing" is readily accomplished without undue experimentation.
19 It follows then that as Claims 39, 47 and 48 meet the standard of
20 definiteness required and explained in §2173.05(b), that the rejection of
21 such claims should be removed. Action to this effect is sought.
22
23

1 Claim Rejections Under 35 U.S.C. 102(e)

2 Claims 39-40, 42-44 and 47 stand rejected under 35 U.S.C. 102(e)
3 as being anticipated by Sukharev (US 5,710,079). Applicant traverses.

4 Applicant's independent Claims 39, 43 and 47 each recite, in
5 pertinent part and in varying language, providing an oxide of hydrogen
6 in a manner that reduces the decomposition rate of an organic silicon
7 precursor. The cited art Sukharev, on the other hand, does not teach
8 or even suggest reducing the decomposition rate of an organic silicon
9 precursor. Rather, Sukharev states that "[t]he present invention is
10 directed to a method ... for increasing the deposition rate of materials"
11 (col. 3, lines 12-13), where the exemplary material deposited is silicon
12 dioxide and TEOS is the exemplary organometallic precursor to the
13 silicon dioxide (ibid, lines 21-25). Thus while the instant application and
14 the cited art share some common elements, Applicant finds it remarkable
15 that such art is presented as anticipating the invention recited in
16 Claims 39, 43 and 47, and respectfully asserts that the Examiner is
17 mistakenly interpreting the teachings of Sukharev to reach the conclusion
18 that such art anticipates Applicant's invention as claimed.

19 To this effect, Applicant directs the Examiner to Sukharev at
20 column 3, lines 26-49 where the manner in which the enhanced
21 deposition rate is obtained. Thus Sukharev states that in accordance
22 with the invention, ozone is provided together with the organometallic
23 precursor to the reaction chamber and simultaneously exposed to UV

1 radiation. The radiation serving to decompose the ozone such that
2 molecular oxygen and atomic oxygen are provided. The latter well
3 known to be extremely reactive and as stated by Sukharev to so react
4 to provide hydroxyl radicals which in turn serve to accelerate the
5 decomposition of the organometallic precursor. In an alternate method,
6 hydrogen peroxide is provided in place of ozone, but again an exposure
7 to UV radiation is employed to produce the atomic oxygen needed to
8 create the hydroxyl radicals that result in the accelerated decomposition
9 of the precursor. Thus Applicant asserts that Sukharev NEVER indicates
10 that the rate of decomposition of the organometallic precursor is
11 increased due to the presence of H_2O/H_2O_2 as alleged by the Examiner
12 in the first two lines of page 6 of the Office Action. Rather, as stated
13 above, Sukharev only represents that the rate is increased by
14 PROVIDING HYDROXYL RADICALS through the photolytic
15 decomposition of ozone or hydrogen peroxide.

16 The chemistry of Sukharev for forming silicon dioxide from a
17 TEOS source is distinctly different from that described by Applicant at
18 page 8, line 16 through page 12, line 24. Sukharev states, as remarked
19 above, that the chemistry of the disclosed method provides conditions for
20 forming hydroxyl radicals, and that this reaction is the key element in
21 providing the enhanced deposition rate (col. 3, lines 34-36). Therefore,
22 the Examiner is mistaken in alleging that since the concentration range
23 for water or hydrogen peroxide recited by Applicant in Claims 40-42

1 overlap the ranges disclosed in Sukharev, that Sukharev must inherently
2 "reduce" the decomposition rate of an organometallic precursor. Such
3 an allegation in view of the cited art actually stating that another
4 reaction, not taught by Applicant, is in fact the key to a result opposite
5 that taught and claimed by Applicant is of course without foundation.
6 As cited by the Examiner, *In re Swinhart* essentially states that there
7 must be a reason for the Patent Office to believe that an asserted
8 functional limitation may be an inherent characteristic of the prior art.
9 Applicant respectfully asserts that for Sukharev, it is UNREASONABLE
10 to allege that "conditions which are effective to reduce the decomposition
11 rate of the organic silicon precursor" can be an inherent characteristic
12 of art that teaches a chemical process that is directed to providing the
13 opposite result.

14 Thus Applicant asserts that *In re Swinhart* and *In re Fitzgerald*, are
15 not germane to the instant application as the shift in the burden
16 suggested by such decisions can only be made where the Examiner
17 presents a reasonable argument regarding such inherency. Here, as
18 Applicant has asserted, the Examiner's conclusion is reached by ignoring
19 the teachings of the cited art as a whole, and in particular the teaching
20 of a chemical process for photolytically forming atomic oxygen as a
21 reagent for providing hydroxyl radicals. Therefore Applicant requests
22 reconsideration of the instant rejection in view of the above remarks.
23

1 It follows then that, absent this inherency, Sukharev does not teach
2 or even suggest all of the elements of Claims 39, 43 and 47 and as a
3 result, the rejection under §102 should be withdrawn. For at least the
4 same reason, the rejection of Claims 40, 42 and 44 which depend,
5 respectfully, therefrom, should also be withdrawn. Action to this effect
6 is earnestly sought.

7
8 **Claim Rejections Under 35 U.S.C. 103(a)**

9 Claim 41 stands rejected under 35 U.S.C. 103(a) as being
10 unpatentable over Sukharev (US 5,710,079). Applicant traverses.

11 The Examiner alleges that Sukharev discloses all of the limitations
12 of Applicant's Claim 41 except for the recited concentration range.
13 Applicant disagrees and refers the Examiner to the discussion above and
14 the conclusion that Applicant believes must be reached after considering
15 that discussion. Applicant's limitation of "conditions which are effective
16 to reduce the decomposition rate of the organic silicon precursor"
17 (emphasis added) cannot be an inherent characteristic of the chemistry
18 employed by Sukharev to achieve an enhanced deposition rate for silicon
19 dioxide. Absent such inherency, Applicant respectfully asserts Sukharev
20 cannot even be held forth to suggest such a limitation as exactly the
21 opposite is actually taught. Such is admitted to by the Examiner at
22 page 6 of the Office Action, although in this admission the Examiner
23 misstates the reason put forth for the enhanced rate. Applicant

1 respectfully directs the Examiner to Sukharev at column 3, lines 34-36
2 where the correct reason is provided.

3 It follows then that Sukharev cannot teach or even disclose
4 "conditions which are effective to reduce the decomposition rate of the
5 organic silicon precursor," such limitation read into Claim 41 through the
6 dependency on Claim 39. Thus, Sukharev does not teach or suggest all
7 of the limitations of the instant claim and does not therefore meet the
8 standard for a rejection under §103. The rejection must therefore be
9 withdrawn.

10
11 Claims 45-46 and 48 stand rejected under 35 U.S.C. 103(a) as
12 being unpatentable over Sukharev in view of Wolf (*Silicon Processing for*
13 *the VLSI Era*, Vol. 1). Applicant traverses.

14 The Examiner alleges that Sukharev discloses all of the limitations
15 of Applicant's Claims 45-46 and 48 except for the different specific types
16 of CVD reactors recited in each of the rejected claims. The Examiner
17 states that Wolf teaches each of these CVD reactors.

18 Applicant disagrees that Sukharev discloses all of the limitations
19 of such claims and refers the Examiner to the discussion above and the
20 conclusion that must be reached therefrom. Applicant's limitation of
21 "conditions which are effective to reduce the decomposition rate of the
22 organic silicon precursor" cannot be an inherent characteristic of the
23 chemistry employed by Sukharev to achieve an enhanced deposition rate

1 for silicon dioxide. As each of the rejected claims recite directly or
2 through a dependence, in varying language, conditions that reduce the
3 decomposition rate of the organic silicon precursor, the above referenced
4 discussion is asserted for the rejection of Claims 45-46 and 48.

5 With regard to Wolf, as Sukharev does not disclose all of the
6 limitations of the rejected claims as alleged by the Examiner and as
7 Wolfe is not put forth to, and in fact does not, teach or suggest the
8 limitation Sukharev is lacking, a combination of Sukharev with Wolfe
9 must also be deficient in teaching or suggesting all of such recited
10 limitations. Hence, Sukharev combined with Wolfe cannot meet the
11 standard required for a rejection under §103 and such rejection must
12 therefore be withdrawn. Such action is requested.

13 In summary, Applicant has shown that the rejections of Claims 39-
14 48 should be withdrawn and such claims sent to issue. If the
15 Examiner's next action is anything other than a Notice of Allowance, the
16 Examiner is requested to call the undersigned to schedule a telephonic
17 interview. Such interview to include SPE Bowers.

18
19 Respectfully submitted,

20
21 Dated: Sept 18, 2000

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